THE RUBBER SHOWCASE IN SUMATRA

Eric A. Penot

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Eric Penot CIRAD-TERA

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1 The Indonesian rubber boom : a progressive evolution.

As with cocoa a combination of available land and centres with fairly dense population is a prerequisite for a boom. But in the case of rubber the boom has been far more progressive than that for cocoa due to 3 main factors. Firstly, Sumatra and Kalimantan islands were almost empty at the turn of the century with population density inferior to 5 inhabitants/km². It took time for migrants (mainly from neighbouring Java in the case of Sumatra) as well as indigenous population (local Dayak and Chinese migrants in Kalimantan) to conquest the vast central plains of Sumatra and Kalimantan[1].

Secondly, however the demand was very strong and rubber prices very attractive, first planting have been physically limited by both distances and seeds availability. The main rubber cropping system has been the jungle rubber system based on the use of unselected seedlings. Seeds were collected in Estates, mainly located in North-Sumatra and West-Java, and then distributed or sold to farmers through networks of traders or missionaries. Another constraint was that seed production was limited to 1 month per year and seeds have to be planted within 4 weeks after harvest[2]. Last, infrastructure and trade were not as developed in the first half of the century as they were in the second half when the cocoa boom occurred (in particular since the 1980's).

Rubber has been immediately seen by local farmers as a very promising crop mainly due to its ability to be combined with the secondary forest regrowth in a complex agroforestry system called jungle rubber (Penot 2001). With unselected rubber seedlings (at no cost), no inputs (no fertilisers nor herbicide ..) and a very limited labour requirement for planting after upland rice, jungle rubber is very easy to implement as it does profit directly from the "forest rent" (Ruf 1987). The lack of capital requirement fo establishment and the very progressive migrations enable us to define jungle rubber as a typical indigenous agroforestry. Jungle rubber being very close to secondary forest in terms of bio-mass and structure, one can consider that jungle rubber do maintain the forest rent and create a sustainable and permanent "agroforest rent ".

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[1]These areas were inhabited by Malayu close to rivers and Kubus people in the primary forests in Sumatra, and by dayaks peoples in in hinterland when the coasts were populated with Malayu, Banjar or Javanese peoples in Kalimantan.

[2] Harvesting time may not be adapted to recommended planting periods for rubber as harvest and climatic conditions differ significantly between North and South-Sumatra due to their respective position around the Equator.

Indonesia is now the second largest producer behind Thailand **(figure 1).**

2 The "bagi" system (share-cropping) as a driving force for migrations from Java to the equatorial outer islands.

One component of the migration and jungle rubber very large extension in pioneer zones has been the flexibility of this agroforestry system. Migrants were first welcome to work as share croppers with the "*bagi-system*" (share-cropping), similar to that used in cocoa plantation. Land was therefore later on allocated as all originally undivided land was, by the community according to the needs as long as it was plentiful. The Malayu world has by this way easily integrated Javanase people (in central plains) and Minang people from the highlands of West-Sumatra (in the piedmont of the Barisan moutains). The bagi-system and the share distribution ratio has always followed the rubber prices. High prices lead to bagi-2 (50 % for the owner) when very low prices lead to bagi-3, 4 or even 5. (1/3, 1/4 or 1/5 for the owner).

3 The rubber cycles : the crisis do not affect the planting dynamic....

In the 1920', the British colonial government decided to implement the "Stevenson plan" in Malaysia with the limitation of large plantations in order to sustain the demand and avoid over-production. Meantime, smallholder rubber plantations in the "Dutch Indies"[3] increase dramatically as smallholders were not concerned legally by the plan. Dutch officials could do nothing against the very popular trend of planting jungle rubber. However rubber did suffer several conjonctural crisis, rubber plantations increase at a very high rate. More than 3 millions ha have been planted and still operated by smallholder from which 85 % is jungle rubber in 2001. It seems clear that in the first phase, rubber did trigger deforestation. But jungle rubber do maintain a relatively high level of vegetal biodiversity, comparable, at the same age, to that of secondary forest (De Foresta 1997) (Werner 1997; Werner 1999). Nowadays, jungle rubber areas are the main reservoir of biodiversity in low lands in Sumatra and West-Kalimantan where most of the forests have disappeared.

Therefore, we see a real forestry dynamic where initial deforestation led to reforestation, at least from a smallholding perspective. Meantime, both monoculture and jungle rubber do maintain respectively a "forest-like rent" for monoculture and an "agroforest rent " for jungle rubber. Replanting of rubber on former rubber planted land is not a major problem contrary to cocoa, at least in most cases.

Historically, local rubber price crisis neither decrease interest and farmers motivations for rubber plantations. The rubber market is directly linked with that of tyres (70 % of the consumption), and therefore to air and surface transportation. This sector has been in constant increase creating a permanent increasing demand. Rubber is also a very strategic product as the WW II showed when Japanese forces took control of the rubber plantations in Southeast Asia and forced both German and American economies to develop in emergency a synthetic rubber industry. More recently, rubber prices were very high in 1994-1997, far above its "normal " price of 1US $ per kg (up to 2 US$). In 1997-2001, the average price fell down to 0.5/0.6 US

[3] Indonesia during colonial times

$/kg[4]. These price trends did not basically change farmers' strategies for rubber considered as a "refuge ", a valuable, flexible and sustainable crop. However, nobody can guess that will happen if low prices continue in the long run.

4 Replanting rubber: from jungle rubber and to clonal rubber based systems.

The replanting problem with rubber is eventually similar to that of cocoa, at least in terms of capital as long as farmers want to shift to clonal rubber systems, with 3 different situations:

- replanting jungle rubber after jungle rubber , with "agroforest rent" similar to cocoa after forest in pioneer zones. Farmers do replant jungle rubber, even in traditional areas[5] because they do not have access to technical information, to clonal improved planting material. Lack of capital is also an important constraint if they do not have clonal rubber or oil palm plantations. Effectively, meantime, jungle rubber is still planted in pioneer areas at the hedges of traditional rubber basins. Here again, the basic rule of relatively low starting capital is confirmed.
- replanting jungle rubber or clonal rubber (either in agroforestry or monoculture system) after *Imperata* : no "forest rent", whatever type, a situation similar to that of cocoa replanting after cocoa.
- replanting clonal rubber based cropping systems after jungle rubber with the "agroforest rent", that is similar to cocoa replanting with clones and inputs after forests.

The main difference with cocoa is that replanting of rubber can be done through traditional jungle rubber or with clonal rubber, the later requiring a minimum of inputs and labour, similar to cocoa. Cocoa replanting is more difficult after a cocoa monoculture with two main problems: the lack of "forest rent" (and its ecological advantages) and a serious increase in pests and diseases problems. With clonal rubber, replanting differs due to both lack of "forest rent", if any and, more, with to the use of a new planting material which requires a relatively more intensive management (in particular weeding). Clonal rubber required good weeding on the rubber rows, therefor either labour, or, better, the use of herbicide against *Imperata*, and a protection against *Fomes* (a root disease) linked with the quality of the burning of the plot before establishment. Another difference is that *Fomes* occurs more after forest if the burning is not sufficient, which is unfortunately generally the case, than in grassland (where no trunks and root systems enable the development of the fungus). Root disease and attacks of vertebrate pests (pigs and monkeys in mountainous areas) are two negative artefacts of the "forest rent" for rubber[6]. But adapted cultural practices (good burning) and presence in the fields overcome these two problems.

Finally, the only significant difference between rubber and cocoa replanting is the fact that rubber does not export nutriments, do not need fertilisation during mature period and maintain, or restore the forest rent through its forestry pattern, in

[4] With its historicaly lowest record in 2001 below 0,5 US$ /kg .

[5] We opposite "traditional areas" to "pioneer zones" considering that after the second generation (25 years) pioneer zones are not anymore "pioneer" but "traditional", in the sense of "rubber areas".

[6] In particular in Muslim areas where pigs are not part of the diet (Malayu and Minang people in Sumatra).

particular with agroforestry systems. However, in the case of export of rubber wood and additional associated trees, then the “forest rent” is limited to the good quality of soil structure and the least weed pressure. In that case, the removed nutriments have to be re-integrated to soils. The growing demand on rubber wood for furniture, fuelwood, plywood or particle board in Southeast Asia, combined with the growing development of clonal plantations (clonal rubber wood is more adapted to these uses than jungle rubber wood) will lead to the generalisation of rubber wood export.

The consequence of this maintaining of the rent forest with agroforestry rubber systems is that farmers do not have to look for another piece of available forest to renew their cropping system, whatever types. There is no move into a new pioneer front nor a production shift at least for that particular reason. Pioneer zones however still exist as population and demand for land increase as long as the “boom” conditions still do exist. In fact, the initial boom is maintained through the rubber demand and does not create another boom in other places with forests. The dynamic of both population and sustainable cropping patterns tend to reforestation through jungle rubber and other improved agroforestry systems (basically those which include clonal rubber planting material and maintain agroforestry practices[7]).

5 Rubber wood as a mean of re-investment in perennial cropping systems.

Eventually, at the end of the rubber life-span, the sale of rubber and other timber wood in agroforestry systems, provide a comfortable capital for future investment that enable farmers to choose whatever new improved perennial cropping system they want. Except in some areas with strong pressure from projects (mainly oil palm), we do not observe a production shift to another crop. In areas where oil palm plantations can be acquired by farmers in exchange of land and full credit, rubber is still a priority. The main strategy in that case is to establish clonal rubber based new plantations.

The dominant exogenous model is monoculture. Around 350 000 ha of clonal rubber monoculture plantations have been successively established through various projects since the 1970’s (from almost officially 500 000 ha as a whole). It is obviously a successful model as long as the required capital and labour is available during the long immature period (5 to 6 years). It is generally the case in rubber projects that provide full credit. The model was for years strictly limited to monoculture with cover-crops in the inter-row requiring a tremendous amount of labour for maintaining. Inter-crops have been forbidden for years without any good technical reasons. Farmers were traditionally used to inter-crop annual food-crops or cash crops such as cocoa and coffee. Jungle rubber is not inter-cropped with food-crops as secondary forest re-growth is part of the system as soon as the second year (only the first year, rubber is inter-cropped with upland rice). We observe two main trends:

- some farmers, according to our surveys and observations in South and North Sumatra, Jambi, West-Sumatra and West-Kalimantan provinces began to reintroduce agroforestry practices as long as extension is not anymore present

[7] Such systems have been observed and experimented on-farm for optimisation since 1994 (SRAP project/ CIRAD/ICRAD). They have been called “ RAS ” for Rubber Agroforestry Systems (Penot 2001).

(generally after the 7th year in NES and SRDP/TCSDP projects). They do replant associated timber and fruit trees and let some species to grow again in the inter-row. The case of the Sanjan village in West-Kalimantan is particularly symbolic of such trend with 1/3 of the farmers implementing such strategy (Schueller, Penot et al. 1997). Between 150 and 300 associated trees are therefore combined with clonal rubber in former purely monoculture plots (SRDP).

- most farmers who establish a clonal plantation adopt monoculture and food-crops inter-cropping for the first 3 years. Inter-cropping has been proven as very effective and positive for rubber (Wibawa 1997). Since 1993, officially, inter-cropping with food-crops is not anymore forbidden but even recommended by project officials. Since then, some farmers reintroduce also associated fruit and timber trees, recreating what makes the success of jungle rubber with agroforestry practices limiting inputs and labour requirements as well as providing income diversification. But in that case, the first phase with "adapted "monoculture is considered as a security for farmers according to the success of the dominant model (at least for the 3 first years which are critical for clonal rubber trees).

Before such strategies, a small scale on-farm research project began on-farm experimentation on 3 types of Rubber Agroforestry Systems (RAS), in full participatory approach with farmers. The objective was to optimise these agroforestry practices according to clonal rubber plants requirements. This experimentation has been successful and enable farmers to increase their potential technical choices between monoculture and RAS systems (Penot E, 1997). RAS systems are based on a better use of the "forest rent", in particular for instance in the use of secondary forest re-growth against *Imperata cylindrica* (with the RAS 1 system for instance , very close to the current jungle rubber). The main economic advantage is that RAS rubber yield is comparable to that of clonal monoculture with lower cost of establishment and maintenance.

The adoption of RAS, considered as "optimised clonal rubber CAF[8]", or monoculture by non-project farmers began to be possible with the capitalisation of both income from clonal rubber and newly established oil palm plantations and technical skills that reduces establishment costs linked with agroforestry practices. Partial approach projects have been developed in the beginning of the 1990's (PKT, P2WK, P2RT....) to profit from the positive secondary effect of the main rubber projects. There are based on the principle that farmers have acquired sufficient skills and capital with former clonal rubber plantations to establish with success new ones.

De facto, surveys in Jambi and West-Kalimantan show that this hypothesis is verified if there is a sufficient "density" of projects. In remote areas in West-Kalimantan without any outfall from existing projects, the partial approach (the PKR-GK project) does not work properly. In other words capital building in a necessary condition but might be not sufficient: technical skills (linked with quality of technical information) and innovation are also pre-requisite.

6 Monoculture versus agroforestry : a cultural component ?

In term of agroforestry practices (practically we are speaking of CAF), we see clearly

[8] CAF = Complex Agroforestry System

differences between ethnies according to the following typology defined after our observations:

- The Dayaks in West-Kalimantan are clearly representative of full integration of CAF (*tembawang*[9], jungle rubber) in their farming system, clearly inherited from the fact that there were forest collectors a century ago. The "forest component" , including of course all CAF, is still very important. Dayaks farmers have a past of hunters and forest products collectors. They have been since centuries in contact with foreigners (Chinese, Malays and Arabs..) to market such products.
- the Malayu in Jambi province for instance are not traditionally so keen to forest. There were used to live close to rivers that were the main means of communications up to the 1950's. They did adopt rapidly jungle rubber but are not particularly keen to other CAF if there are no specific advantages.
- the Javanese spontaneous migrants are close to Malayu in terms of strategy. They generally settle down beginning income generation with share cropping.
- The Javanese in official transmigration areas give priority to *sawah* (irrigated rice) and do adopt perfectly monoculture (rubber or oil palm). Their land is already very limited (2.5 ha/family) and they will traditionally adopt more intensive system. They do shift to rubber RAS systems for instance only if labour is limited or in *Imperata* grassland, for less risky systems. At that point agroforestry practices are generally seen more adapted, less risky and less input and labour consuming that intensive crops such as monoculture.
- the Minangkabau people from West-Sumatra. They are very keen to highly intensive *sawah* systems (irrigated rice with "green revolution" technological packages). Meanwhile, they also do develop very adapted CAF systems such as jungle rubber , RAS or fruit/timber/cinnamon based CAF. The RAS experimentation in East-Pasaman is very promising (Boutin 2000). These people are both traditionally irrigated rice farmers and CAF farmers.

But, all these peoples with various cultural characteristics have adopted jungle rubber as it was the most adapted system to their conditions. In other words, the situation and constraints supported by local farmers seems to be more important than the cultural fact in itself.

In conclusion , if the cultural component can be a very important feature of farmers 'strategies in terms of production and environment policies, it seems that it is more the agro-ecological situation that makes them adopting CAF rather than a specific ethnic feature. The best proof, if any, of this trend is the fact that jungle rubber has been adopted by all ethnic groups, whatsoever, where rubber could be planted.

7 Following the cocoa model ?

With regard to most criteria such as land availability, migration, monoculture related to migrations, labour contracts as investment multipliers, starting prices, relative prices and the smallholder effect, starting capital and information, acceleration by the experience and capital acquired by 'accumulators', the "cocoa Sulawesi" case displays some original features but seems to follow the 'cocoa cycle model' (Ruf 2002) fairly well in the two main ways: some pioneer cocoa regions may lose ground

[9] *Tembawang* are fruit and timber based complex agroforestry systems.

but the boom can renew itself in new regions. It even seems at a turning point in 1997/98 as Côte d'Ivoire was in the early 1970s.

For Indonesia, rubber seems also to follow relatively well the model with slight differences depending on the type of cropping systems (jungle rubber or clonal rubber based CAF or monoculture) and on the "duration" of the boom. The rubber boom is in fact a long term boom. The initial boom has been successfully followed by a significant and maintained trend in plantation. The rubber cycle might be seen on a different frequency. Basically, jungle rubber maintains the forest rent but does not provide sufficient income for a complete replanting with clonal rubber. In other words, the jungle rubber system has been at the origin of the rubber success story. But its does not have in itself the economic potential for evolution and technical change.

Replanting problems are directly linked with the specific requirements of clonal rubber (similar to that of cocoa) either in CAF or in monoculture compared to the "no requirement" of unselected rubber seedlings in a jungle rubber. The consequence is that rubber replanting does not require another forested area for another boom. That is the main difference with the cocoa case. But the sector requires i) the official reconnaissance of improved agroforestry systems as viable rubber cropping systems and ii) a minimum of capital investment.

Of course neither the severe 1997 drought nor the dire monetary crisis which followed can be interpreted as endogenous factors of the model. They are exogenous. However, the severe impact of the drought on mono-cropped cocoa in the hills which were already deforested several years ago is full part of the model. Then the price jump clearly accelerate the model functioning. In the case of rubber, impact of drought is far less than that for cocoa. Meantime, we observed a long term depreciation of rubber prices since 1997 with a stabilisation around 0,5 US$/kg since 2000 .

As described by the model by F Ruf for cocoa in Sulawesi, the immediate impact of the drought in 1997 and of its negative effects on cocoa farms in the hills far from the pioneer fronts will be more cocoa migrations to new forest regions and opening of new pioneer fronts in the years to come and many more forest clearings and plantings. This is not the case with rubber. Rubber is however facing a new challenger with oil palm in traditional rubber areas.

Then in coherence with the model, the cocoa price jump to some 15,000 current rupiahs per kg in May 1998 from Rp 2,500 in May 1997 will also have an enormous impact in terms of further migrations, forest clearings and new cocoa plantings. Again, as described in the model, as it has been observed in Côte d'Ivoire (Ruf 1994), the experience in cocoa farming and the accumulated cocoa savings will make the accumulators much more found of large pieces of forest land in the near future. This is different for rubber as the rubber planting dynamic by smallholder has never been really directly affected by rubber prices. The time between planting decision, effective planting and first harvest (6 years with clonal rubber, 10 to 15 years with jungle rubber) is far more than that of rubber prices small cycles.

In another words, prices fluctuations might have not been sufficiently significant at farmer's level to increase or decrease the planting trend. Another point is that the

immature period with jungle rubber: between 8 and 15 years, plays a role of buffer in reactions to prices. The significant reduction of the immature period when using clonal rubber, around 5 to 6 years, might lead to farmers more sensitive to prices with a situation similar to that of cocoa (immature period of 3 years). But generally, smallholding reaction to external factor such as prices, temporary crisis, is smooth and it takes more time for real effect on production or planting strategy.

8 A specificity with regard to the forest rent due to the alluvial plain rent and possibly to technical progress and herbicides

The Sulawesi case may have strong specificity with regard to forest rent (Ruf 2002). Firstly, most of its alluvial plains were either under fallow or/and cultivated with annual crops before cocoa was introduced. Thus, in the plains, and in relation to this 'plain rent', cocoa has turned out to be a 'reforestation agent' rather than a cause of deforestation. This is a new status in cocoa history. Rubber has a different story. It is clearly the deforestation factor up to the 1950's (now it is oil palm and industrial timber plantations for pulp (*Acacia mangium)* since the 1980's). Due to its complex agroforestry nature, jungle rubber is also the main reforestation factor, with a long life-span or more than 35 years (compared for instance to *Acacia mangium* plantations with a rapid turn-over of 8 years).

Secondly, Indonesia is one of the few cocoa and rubber producing countries which benefits from recent but widespread use of herbicides. This input and the widespread use of fertilisers should significantly reduce replanting problems in the alluvial plains for cocoa. It will help the replanting with clonal rubber (and not only in rehabilitating *Imperata* grasslands). Even if it is not the current fashion with environmentalists, such use of fertilisers and herbicides may help to escape the boom-to-bust cycle or at least to delay it. Clearly, as mentioned in the possible limits of the model, based on the Côte d'Ivoire testimony, the technical progress may change the functioning of the model, at least slowdown the switch to the bust.

Conclusion: Prospective for rubber in Indonesia, the first world rubber producer.

Rubber will continue its long trend of continuous but progressive expansion due to 3 factors (see **figure 2).** Firstly, because the demand is and will be sustained for the next 20 years as natural rubber market is directed for 70 % to tyres market and to transportation market as a whole which is constantly increasing. Secondly because 3 millions hectares will have to be partly converted into clonal rubber plantations in the very next future with a productivity multiplied by 3 or 4 compared to that of jungle rubber, leaving smallholders with a fantastic "reservoir of productivity". Labour productivity can also be significantly increased by using tapping systems with low frequency and stimulation, saving between 30 to 60 % of labour depending on tapping frequency for the same production. Last, because Indonesian farmers are the best placed in terms of labour cost and structure to take the market shares left by countries like Malaysia, or the new emerging markets. Jungle rubber will continue to be the most favoured cropping system in pioneer zones with poor farmers when replanting in traditional zones will rely now on the use of clonal rubber.

Which is at stake in the very next future for smallholders is the following question: which type of clonal rubber based system : monoculture or improved agroforestry systems?

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Figure1

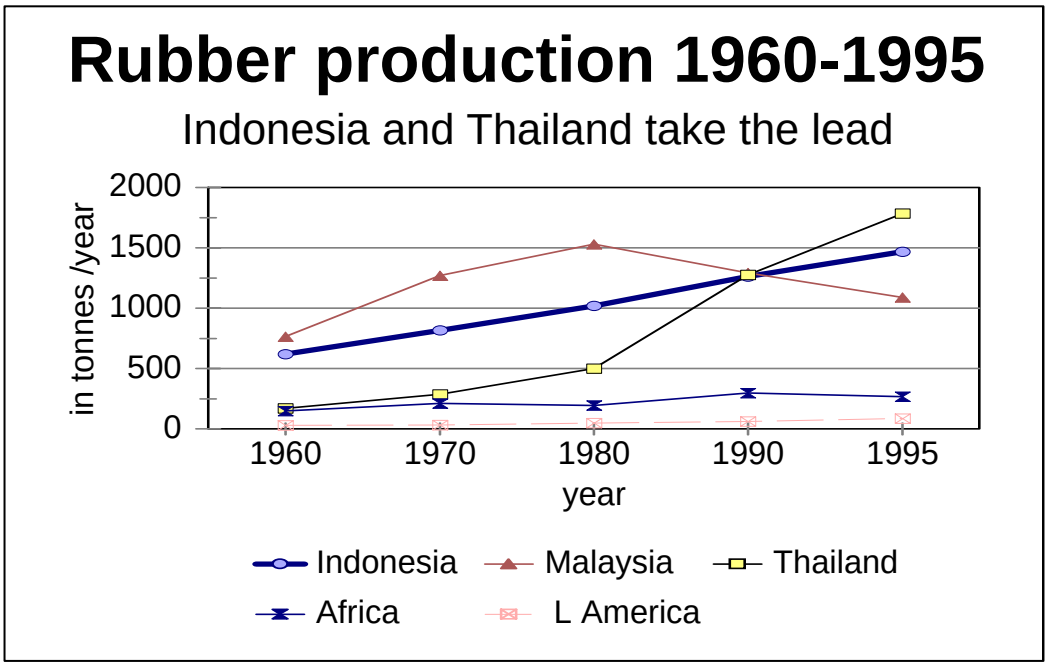

Figure2